



Humpback Whale Monitoring in Glacier Bay and Adjacent Waters 2013

Annual Progress Report

Natural Resource Technical Report NPS/GLBA/NRTR—2014/886



ON THE COVER

Humpback whale #1803 (age 10) lunge feeds in Icy Strait, August 2013.
Photograph courtesy of Glacier Bay National Park and Preserve.

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Abstract

Migratory endangered humpback whales (*Megaptera novaeangliae*) from the Central North Pacific stock use southeastern Alaska as summer feeding habitat, including the waters in and around Glacier Bay National Park and Preserve (GLBA). This report summarizes the findings of GLBA's humpback whale monitoring program in 2013, the twenty-ninth consecutive year of consistent data collection in Glacier Bay and Icy Strait (GB-IS). From June through August, the number of whales in GB-IS ($n = 237$; including 10 mother/calf pairs) was the highest count ever documented. One hundred and forty-eight whales (62%), including six mother/calf pairs, met our definition of 'resident' (remaining 20 or more days in the study area). This highlights the importance of GB-IS as a summer feeding ground for humpback whales. The numbers of whales in Glacier Bay ($n = 160$) and Icy Strait ($n = 202$) were also the highest counts ever documented. We collected a record-high number of sloughed skin samples ($n = 29$; including three samples from calves) for genetic analysis. Capelin (*Mallotus villosus*) appeared to be unusually abundant in Icy Strait and lower to middle Glacier Bay compared to previous years. Point Adolphus did not develop into the consistent hot spot of whale activity that has been typical of previous years and to our knowledge, it was the first year since monitoring began in 1985 that the "core group" did not form. We documented several whale/human interactions, including two whale-vessel collisions in Icy Strait.

Acknowledgments

Whale sightings, behavioral observations and enthusiasm from Park staff and volunteers continue to play an important role in this long term study. We extend our gratitude to Bruce McDonough for keeping the *Sand Lance* running smoothly for another productive season. We thank Katja Mocnik for assisting with data analysis. We appreciate Park staff who reported whale sightings, and the Park's Visitor Information Station for recording them and passing them along to us. We especially appreciated the many sightings we received from Nat Drumheller, Deb Johnson and Dena Matkin. We thank Yumi Arimitsu and Craig Murdoch for their help with fish identification. We extend a big thanks to Hank Lentfer, Sean Neilson, Bob Christensen, Mike Halbert, Chuck Schroth, Bruce Smith, Fred Howe, Holly Enderle, Jim Kearns, Tod Sebens, Janusz Kunat, Wayne Carnes, Merry Ellefson, and Arne Ellefson-Carnes for sharing their field observations. We appreciate our long and fruitful collaboration with Jan Straley and Jennifer Cedarleaf at University of Alaska Southeast in Sitka. Thanks to Fred Sharpe for sharing the new, improved Alaska Whale Foundation humpback whale fluke catalog and Robin Abernethy, Pacific Biological Station, Nanaimo, British Columbia, for sharing information on BC whales. Thanks to Kaili Jackson, Aleria Jensen, Kate Savage and Ed Lyman [National Oceanic and Atmospheric Administration (NOAA)] for investigating, compiling and sharing data on humpback whale strandings and entanglements in Alaska. We thank Christopher Sergeant and Jamie Womble for reviewing this report and providing valuable comments.

National Park Service (NPS) data from 1988 to 1990 were collected by Jan Straley. NPS data from 1985 to 1988 were collected by C. Scott Baker. This work was carried out under NOAA Fisheries Permit #15844.

Introduction

This report summarizes the findings of Glacier Bay National Park and Preserve's (GLBA) humpback whale (*Megaptera novaeangliae*) monitoring program during the summer of 2013, the twenty-ninth consecutive year of consistent data collection in Glacier Bay and Icy Strait. The initial impetus for this program stemmed from concern in the late 1970s that increased vessel traffic in Glacier Bay may have caused a large proportion of the local whale population to abandon the bay (Jurasz and Palmer 1981). The federal government is mandated to ensure that park management decisions do not negatively impact endangered species such as humpback whales. Therefore, each summer Park biologists document the number of individual humpback whales in Glacier Bay and Icy Strait, as well as their residence times, spatial and temporal distribution, reproductive parameters and feeding behavior. Residence times are valuable because they reflect site fidelity and habitat use. These data are used as an index to monitor long-term trends in the population's abundance, distribution and reproduction. Long term and consistent data collection in longitudinal studies is extremely rare and valuable in understanding the population parameters and trajectory of an endangered species. A summary of whale/human interactions in the study area and elsewhere in Alaska has been included in this report since 2003 to document trends in whale conservation issues such as entanglements and vessel collisions. Photographic identification data are shared with other researchers studying North Pacific humpback whales. In addition, Park biologists use whale distribution data on a daily basis to make recommendations regarding when and where GLBA 'whale waters' vessel course and speed restrictions should be implemented in Glacier Bay.

The humpback whales in the study area are part of the southeastern Alaska (SEAK) feeding herd which is in turn a part of the central North Pacific stock. Humpback whales in this stock winter mainly in the Hawaiian Islands and migrate in the summer to feed in northern British Columbia and SEAK, the Gulf of Alaska and the Bering Sea/Aleutian Islands (Baker *et al.* 1990; Perry *et al.* 1990; Calambokidis *et al.* 1997). In SEAK, the most recent population estimate was 1585 whales in 2008 (95% central probability interval: 1455, 1644) (Hendrix *et al.* 2012). This is considered the minimum population estimate for SEAK because no data were collected in southern SEAK. From 1985 to 2012, the number of individual whales documented in Glacier Bay and Icy Strait ranged from 41 to 219 (Neilson *et al.* 2013), which closely matches population size estimates for this area derived from capture-recapture statistical analyses (Saracco *et al.* 2013). From 1985-2009, the average annual rate of population growth in Glacier Bay and Icy Strait was 4.4% (95% CI: 1.7%-7.0%) (Saracco *et al.* 2013).

Humpback whale movement throughout SEAK is presumed to be linked with prey availability, which likely influences the number of whales in the study area (Baker *et al.* 1990; Krieger 1990; Straley and Gabriele 1995; Straley 1994). Whales in Glacier Bay and Icy Strait typically feed alone or in pairs, primarily on small schooling fishes such as capelin (*Mallotus villosus*), juvenile walleye pollock (*Theragra chalcogramma*), sand lance (*Ammodytes hexapterus*) and Pacific herring (*Clupea pallasii*) (Wing and Krieger 1983; Krieger and Wing 1984, 1986). Notable exceptions are the large, stable "core group" that commonly feeds at Point Adolphus in Icy Strait, and less consistent large aggregations of whales that gather to feed at various locations in Glacier Bay and Icy Strait (NPS unpublished data).

Methods

The methods used for this annual monitoring program have been described in previous reports. The primary techniques have not changed significantly since 1985, allowing for comparison of data between years. The specific methods used in 2013 are outlined below.

Vessel Surveys

We conducted surveys in Glacier Bay and Icy Strait from April 30 through October 29, 2013. We searched for, observed and photographed humpback whales from the *Sand Lance*, a 5.8-meter motorboat based in Bartlett Cove and equipped with a two-stroke Evinrude E-TEC 150 HP outboard engine. To minimize the potential impact that monitoring efforts might have on whales, we typically did not conduct surveys in the same area on consecutive days.

The study area included all of Glacier Bay and most of Icy Strait (Fig. 1) with a primary survey area covering the main body of Glacier Bay (roughly defined by four corners: Point Gustavus, Point Carolus, Geikie Inlet and Garforth Island) contiguous with a primary survey area in central Icy Strait (roughly defined by four corners: Point Gustavus, Point Carolus, Pinta Cove and Mud Bay). Between June 1 and August 31, we surveyed the primary study area in Glacier Bay 3-4 days per week, focusing the day's effort in a particular part of the study area. We surveyed the East Arm of Glacier Bay (to the mouth of Adams Inlet) and the West Arm of Glacier Bay (to Russell Island) infrequently. We did not conduct surveys in any Park designated non-motorized waters. We surveyed Icy Strait approximately once per week, with the greatest survey effort focused in the primary survey area. When whale numbers in Icy Strait were high and the weather allowed, we sometimes surveyed Icy Strait two or more times per week. Glacier Bay is the main area of NPS management concern with regard to whales, but descriptions of the whales' use of Icy Strait provide essential context for the Glacier Bay results because whales frequently move between these areas and because Park waters include portions of Icy Strait. Several Icy Strait surveys included the waters around Lemesurier and Pleasant Islands and the mouths of Dundas Bay and Idaho Inlet.

The intent of the survey protocol is to photographically identify as many whales as possible in the study area between June 1 and August 31 in a manner that is comparable between years. We use a mixed approach in which we go to 'hotspots' where whale sightings have been reported or are very probable, while also surveying outlying areas where whales may or may not be present. We strive for five surveys per week that cover the entire primary survey area (Fig. 1). Survey effort is only systematic to the extent that we aim to survey a particular portion of the study area on a given day and we generally do not survey the same area on consecutive days. However, where the whales actually are, and how many there are dictates where the survey takes place and how much area we cover each day. Gathering life history data on individual whales is a secondary goal of the study, made possible by the whales' strong site fidelity to the study area and the high level of effort with which we cover the study area. The geographical distribution of whales is primarily of interest to the extent that it influences vessel management (*e.g.*, whale waters). Therefore, the true distribution of whales is not represented by our monitoring data because our data are biased towards areas where vessel management is a concern. We limit our observations to good to fair ocean and visibility conditions [*e.g.*, in most cases, Beaufort ≤ 3 , seas < 0.6 m (2 ft) and visibility > 0.8 km (0.5 mi)] and we make periodic stops to scan with binoculars and listen for blows to keep our detection rate of whales high. This survey approach,

Humpback Whale Monitoring Program Study Area

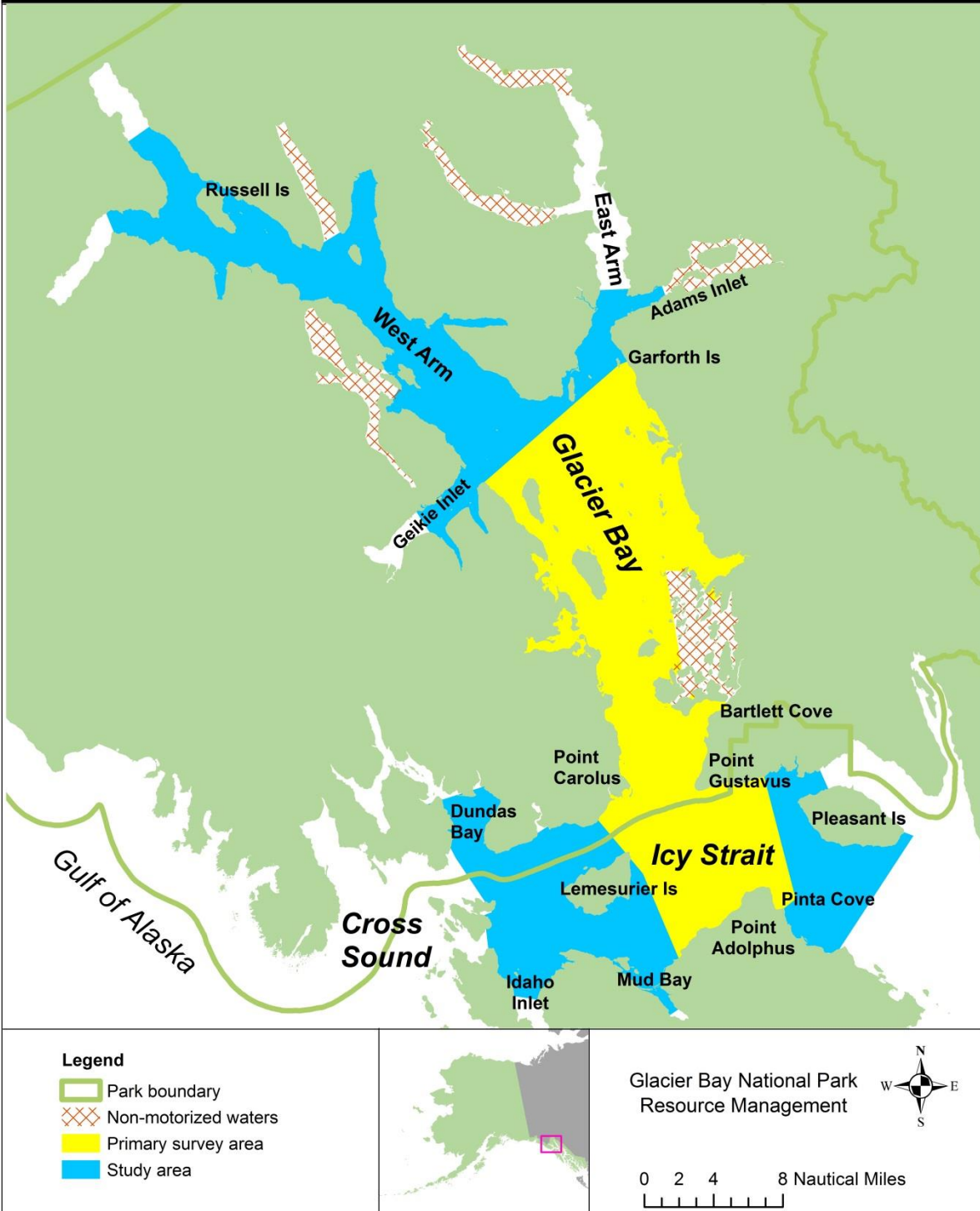


Figure 1. Study area in Glacier Bay and Icy Strait showing primary survey area and non-motorized waters.

combined with a high level of effort, approximates a census that identifies most of the whales in the study area in a given summer. In a recent study, capture-recapture statistical techniques were applied to GLBA humpback whale monitoring data collected from 1985-2009 and revealed that our annual whale counts accurately capture about 90% of the non-calf whales in the study area (Saracco *et al.* 2013).

We defined survey effort hours as only those hours that we spent actively surveying for whales (*i.e.*, transit time to/from Bartlett Cove was not counted). We defined a survey “day” as any day with survey effort hours in Glacier Bay or Icy Strait, thus we counted days in which there was survey effort in both Glacier Bay and Icy Strait as one Glacier Bay day and one Icy Strait day.

We defined a pod of whales as one or more whales within five body lengths of each other, surfacing and diving in unison. We defined a shoal as a group of whales composed of subgroups that were within five body lengths of each other that were not necessarily surfacing and diving in unison and in which associations between individuals were fluid and ephemeral. Upon locating a pod or a shoal, we recorded the latitude and longitude coordinates of their initial location, determined with a GPS. We recorded on field datasheets all information pertaining to the pod or shoal, including the number of whales, their activity (feed, travel, surface active, rest, sleep, unknown), sketches of the markings on their tail flukes and dorsal fin, photographs taken, whale identity (if known), water depth, temperature and any prey patches observed on the depth sounder. If the whales were feeding we categorized their feeding behavior as subsurface, vertical lunge, lateral lunge, bubble net, other bubble, flick or unknown (Jurasz and Jurasz 1979).

Individual Identification

The ventral surface of each whale's flukes has a distinct, stable black and white pigment pattern that allows for individual identification (Jurasz and Palmer 1981; Katona *et al.* 1979). For some whales, the shape and scarification of the dorsal fin also serve as unique identifiers (Blackmer *et al.* 2000). We took photographs of each whale's flukes and dorsal fin with a Nikon D90 digital camera equipped with a 100-300 mm zoom lens. We compared fluke and dorsal fin photographs to previous NPS photographs and to photographs of other humpback whales from SEAK (University of Alaska Southeast, unpublished data) to determine the identity and past sighting history of each whale.

We referred to many whales by a permanent identification number common to the combined catalogs of GLBA and University of Alaska Southeast researcher Jan Straley (<http://alaskahumpbacks.org/flukeIDcatalog.html>). We also referred to those whales first photo-identified by Jurasz and Palmer (1981) by their nicknames. We only assigned calves a permanent identification number if we obtained at least one adequate photograph of the calf's flukes and the calf was sighted on more than one day. For calves that did not meet these criteria, we assigned a temporary unique identifier in the format “mother's identification number_calf_year” (e.g., 1235_calf_2012). For non-calf whales that had not been previously identified in Glacier Bay and Icy Strait, we assigned temporary alphanumeric identification numbers. We replaced these temporary numbers with permanent identification numbers if we identified the whale on more than one day or if the whale was identified elsewhere by another researcher. Photographic and sighting data were added to a relational database containing Glacier Bay and Icy Strait whale sighting histories from 1977 to 2013. We also printed and catalogued the best 2013 identification photograph (fluke or dorsal fin) of each individual.

Whale Counts

We examined the 2013 photographs to determine the number of distinct individual whales observed. We made separate counts of the number of individual whales that we sighted in Glacier Bay, Icy Strait and the combined GB-IS area for the dedicated monitoring period (June 1 - August 31) and for a 'standardized period' (July 9 - August 16) (after Perry *et al.* 1985). We used the “line drawn between Point Gustavus and Point Carolus” [found in Park regulations defining Glacier Bay (Title 36 Code of Federal Regulations (CFR) Subpart N, 13.1102)] to separate Glacier Bay and Icy Strait and assigned sightings north of the line to Glacier Bay and sightings south of the line to Icy Strait. Although the standardized period is substantially shorter than the current NPS monitoring period and the beginning and ending dates have no particular biological significance, we continue to use the standardized period because it provides the only valid means of comparing whale counts in 1982-1984 to later years (Gabriele *et al.* 1995b).

Residency

We determined the number of whales that were ‘resident’ in the study area. We defined a whale as resident if it was photographically identified more than once in Glacier Bay and/or Icy Strait over a span of 20 or more days (after Baker 1986). Under this definition, it is possible that an individual could leave Glacier Bay or Icy Strait in the interval between our sightings, then return, and be counted as a resident in the study area as long as 20 or more days had elapsed between two or more GB-IS sightings.

Reproduction and Juvenile Survival

We defined the following age classes: calves (less than one year old), juveniles (age 1-4 years, as determined by prior sighting history) and adults (age ≥ 5 years) (Chittleborough 1959). We monitor the reproductive histories of individual females and document the return and recruitment of these offspring into the population. We calculated crude birth rate as an index of reproduction by dividing the number of calves by the total whale count from June 1 - August 31. ‘Known age’ whales are non-calf whales whose birth year is known from photo-identification.

Genetics

We opportunistically collected sloughed skin on the sea surface with a small dip net when whales breached or performed other surface active behavior. We stored these sloughed skin samples in plastic canisters filled with dry table salt (NaCl). We archived half of each skin sample at GLBA (in dry salt) and sent the other half to be archived (frozen at -80° F) at the National Marine Fisheries Service Southwest Fisheries Science Center where they are available on request to other scientists studying a variety of topics.

Feeding Behavior and Prey Identification

We recorded instances when we observed probable whale prey such as small schooling fish in the vicinity of whales. In addition, we opportunistically collected anecdotal reports of whale prey in the study area. We used field guides (Smith and Johnson 1977; Pearse *et al.* 1987; Hart 1988; Mecklenburg *et al.* 2002) and/or provided high resolution photographs to fish identification experts to taxonomically identify sample prey items that we collected opportunistically at the surface using a dip net.

Whale/Human Interactions

‘Whale waters’ are defined by NPS regulation as “any portion of Glacier Bay, designated by the superintendent, having a high probability of whale occupancy, based upon recent sighting and/or patterns of occurrence” (Title 36 CFR Subpart N, 13.1102). The whale observations from this study are used to make recommendations to the superintendent on where and when whale waters should be implemented. Vessel course and speed restrictions have long been used to reduce whale disturbance and collision risk in whale waters (Title 36 CFR Subpart N, 13.1174). Speed and course restrictions are both important aspects of whale protection because the increasing whale population combined with whales’ unpredictable distribution means that whales are often in mid-channel as well as within one mile from shore.

We opportunistically documented whale/human interactions in the study area including strandings, entanglements in fishing gear and disturbance by vessels and aircraft. We summarized whale/human interactions elsewhere in Alaska based on stranding data compiled by the NOAA Alaska Region Office of Protected Resources. In addition, we opportunistically collected reports of interactions in Alaska such as vessel collisions and entanglements via the media and anecdotal observations from the public. While our reporting is likely not all inclusive because under-reporting is known to occur, we attempted to document the number and types of whale/human interactions to the best of our ability.

Notable Behavioral Observations

We summarized any unusual or notable whale behavior that we observed while photographing whales in the study area. In addition, we opportunistically collected anecdotal reports of unusual or notable whale behaviors in the study area.

Results and Discussion

Vessel Surveys

We conducted vessel surveys for humpback whales for a total of 309 hours in the combined Glacier Bay/Icy Strait study area (Table 1, Fig. 2). The number of hours we spent surveying in Glacier Bay and the study area as a whole in 2013 was above average, while the number of hours we spent surveying in Icy Strait was comparable to the average for 2005-2012. Compared to 2012, we spent more time surveying in Glacier Bay and less time surveying in Icy Strait based on where most of the whales were distributed in 2013. Although we strive to maintain a comparable level of overall survey effort each year, it inevitably fluctuates as a result of inter-annual variability in uncontrollable factors such as weather, availability of staff and the frequency of unexpected events that detract from our ability to conduct surveys (*e.g.*, mechanical difficulties and marine mammal strandings).

Whale Counts

From June through August, we documented record high numbers of whales in the study area as a whole and in sub-areas Glacier Bay and Icy Strait (Fig. 3, Appendix 1). The number of whales in the study area ($n = 237$) was 8% higher than the previous high count of 219 whales in 2011. Likewise, the number of whales in Glacier Bay ($n = 160$) was 7% higher than the previous high count of 149 whales in 2011 (Neilson *et al.* 2012). The number of whales in Icy Strait ($n = 202$) represents a 14% increase over the previous high count of 177 whales in 2012 (Neilson *et al.* 2013). The standardized period counts (July 9 - August 16) reflect this same general trend, with an unprecedented number of whales in the study area as a whole ($n = 209$) and in Icy Strait ($n = 158$). The number of whales in Glacier Bay during the standardized period ($n = 124$) was 43% higher than in 2012 ($n = 87$) but did not exceed the record high standardized period count in 2011 ($n = 132$).

We observed an additional 10 whales only outside of the regular June through August monitoring period, for a grand total of 247 individual whales in 2013. Overall the humpback whale population in the study area is growing with an estimated 4.4% annual rate of increase between 1985 and 2009 and an even greater rate of increase from 2002 to 2009 (approximately 7.7% per year) (Saracco *et al.* 2013). It is difficult to quantify the relative contributions of factors that may account for the apparent accelerated population growth we have observed in GB-IS in recent years. Potential factors include increased prey availability causing increased use of the study area, changes in reproduction and recruitment, reduced mortality and changes in whale behavior. However, the relative contributions of these factors are unknown at this time.

Twenty-eight of the whales that we documented in the study area in June, July and August (not including dependent calves) were considered “new” because they had not been sighted previously in Glacier Bay or Icy Strait. The percentage of new whales in the study area (12%) matched the 1985-2012 average (12%). Six more new whales were documented outside of the June through August monitoring period, for a grand total of 34 new whales in 2013. This total matches the previous record high count of 34 new whales in 2011 (Neilson *et al.* 2012).

Fourteen of the 34 new whales in 2013 appeared to be small to medium in body size which indicates that they may have been juveniles. Five whales were adults known to have been sighted

elsewhere in SEAK (University of Alaska Southeast, unpublished data; Alaska Whale Foundation, unpublished data). Two whales had not been documented in SEAK but had been

Table 1. Monthly & Annual Survey Effort, 1985-2013.

YEAR	MAY		JUNE		JULY		AUG		SEPT		TOTAL # SURVEY DAYS		TOTAL # SURVEY HOURS		
	# survey days		# survey days		# survey days		# survey days		# survey days		(Jun 1 - Aug 31)		(Jun 1 - Aug 31)		
	GB	IS	GB	IS	GB	IS	GB	IS	GB	IS	GB	IS	GB	IS	GB+IS
1985	0	0	10	7	11	4	10	3	0	1	31	14	234	92	326
1986	0	0	13	5	17	3	6	6	0	2	36	14	-	-	-
1987	3	2	12	5	12	7	5	7	1	2	29	19	-	-	-
1988	0	0	11	5	12	7	12	5	7	3	35	17	199	108	307
1989	3	1	17	6	14	6	16	7	1	4	47	19	231	123	354
1990	6	4	16	5	18	6	14	8	0	0	48	19	215	115	330
1991	7	3	14	7	17	6	13	4	6	3	44	17	256	100	356
1992	3	2	19	4	17	5	12	4	7	1	48	13	248	71	319
1993	2	1	10	3	13	3	7	5	1	1	30	11	192	62	254
1994	1	0	9	5	10	4	13	8	1	1	32	17	169	92	261
1995	3	2	10	4	11	4	10	7	2	2	31	15	167	90	258
1996	4	2	11	5	17	10	16	3	3	1	44	18	259	116	374
1997	5	2	17	4	21	7	19	6	9	4	57	17	327	90	417
1998	10	4	20	3	23	6	12	4	5	2	55	13	344	64	408
1999	4	1	16	4	18	6	18	3	5	1	52	13	318	64	382
2000	1	0	21	8	21	5	23	6	5	1	65	19	321	84	405
2001	3	1	17	6	14	5	20	5	6	2	51	16	236	76	312
2002	3	1	19	6	19	4	18	2	4	2	56	12	297	68	365
2003	5	0	20	7	19	5	16	5	3	1	55	17	283	101	384
2004	6	2	21	3	19	5	21	5	8	2	61	13	373	74	447
2005	1	0	16	5	17	3	12	3	4	3	45	11	216	56	272
2006	2	2	14	6	15	7	16	7	5	1	45	20	197	85	282
2007	4	2	15	10	14	7	14	6	5	2	43	23	206	117	323
2008	4	1	16	10	14	8	12	9	3	1	42	27	187	117	304
2009	6	5	12	10	16	9	10	5	5	4	38	24	179	107	286
2010	5	3	14	9	11	11	17	8	3	5	42	28	194	99	293
2011	3	1	13	10	14	6	13	7	5	3	40	23	189	110	299
2012	5	2	11	8	12	9	12	10	4	2	35	27	144	129	273
2013	7	4	13	7	16	12	19	7	5	1	48	26	208	102	309
2005-2012 average survey effort:											41.3	22.9	188.9	102.6	291.5

The dashed line highlights a change in the way survey effort was calculated beginning in 2005 (Neilson and Gabriele 2007).

Total # survey hours are not available for 1986 & 1987.

Humpback Whale Distribution

Glacier Bay and Icy Strait 2013

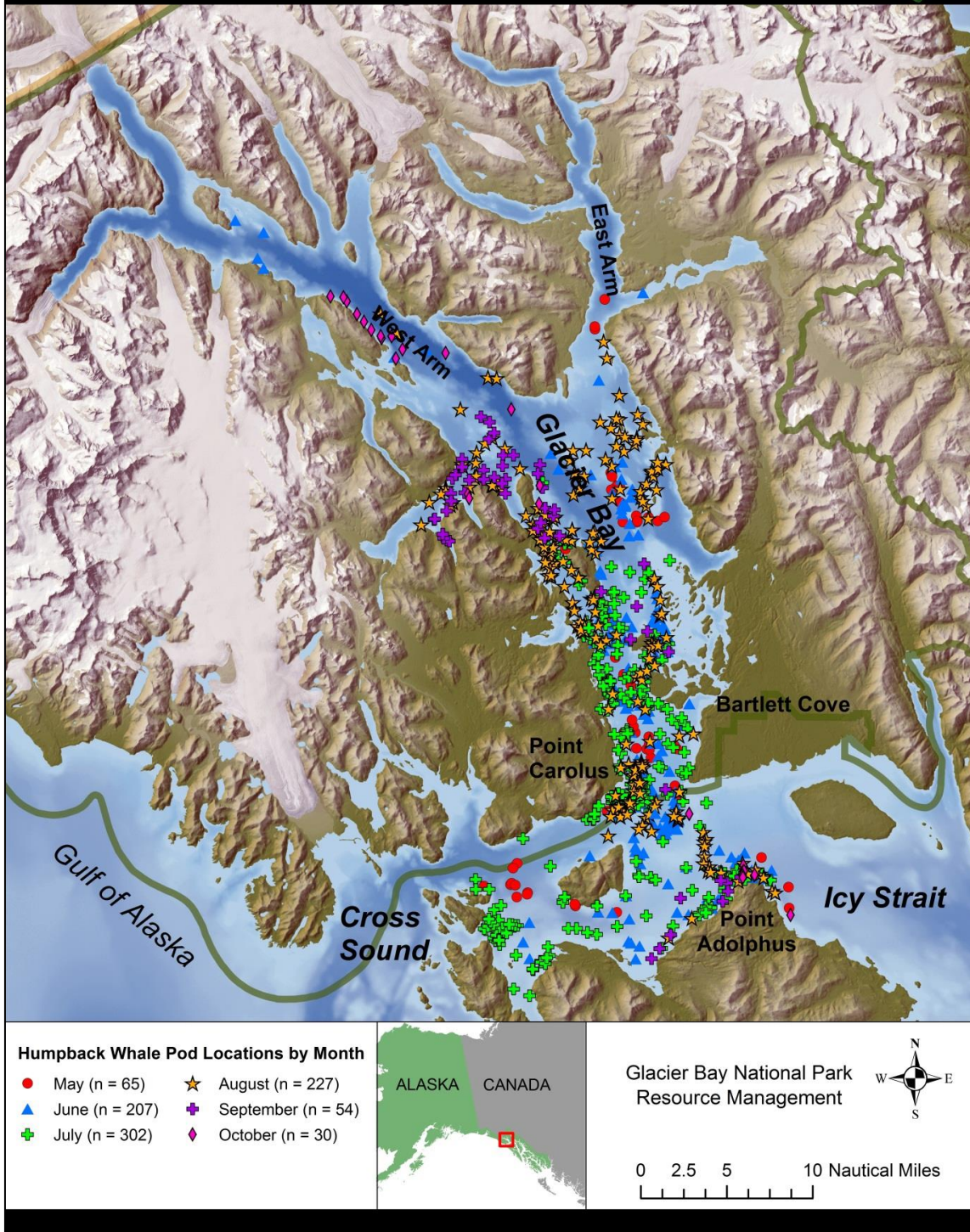


Figure 2. Study area in Glacier Bay and Icy Strait showing distribution of humpback whale pods in 2013. Each symbol represents a pod containing one or more whales.

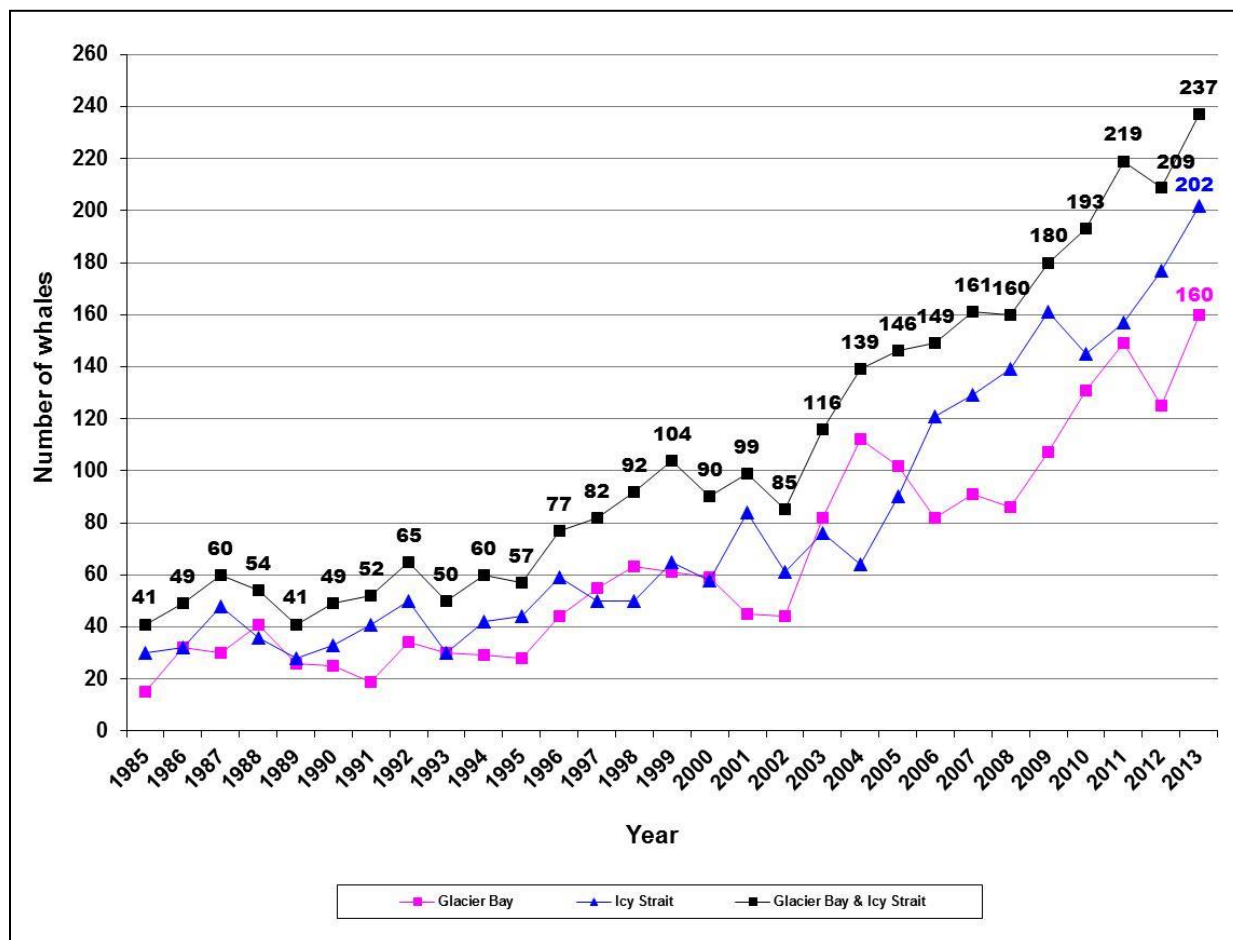


Figure 3. Number of individual whales documented in Glacier Bay & Icy Strait from June 1 through August 31, 1985-2013.

observed off British Columbia (Pacific Biological Station, Nanaimo, British Columbia, unpublished data). The remaining 27 new whales did not match any of the individuals in the SEAK or British Columbia fluke catalogs (University of Alaska Southeast, unpublished data; Pacific Biological Station, Nanaimo, British Columbia, unpublished data). The number of new whales ($n = 27$) was slightly higher than the previous record set in 2011 when 26 unknown whales were identified (Neilson *et al.* 2012).

Residency

In 2013, 148 (62%) of the 237 whales that we documented in the study area between June 1 and August 31, including six mother/calf pairs, remained 20 or more days, meeting our definition of “resident.” This proportion is similar to recent years and highlights the importance of the Glacier Bay-Icy Strait region as a summer feeding ground for many humpback whales. Furthermore, monitoring results over many years have shown that while some whales are exclusive residents to Glacier Bay or Icy Strait, many move frequently between the two areas, demonstrating that the Glacier Bay-Icy Strait ecosystem is a single contiguous habitat (*e.g.*, Neilson *et al.* 2012).

Forty-seven (20%) of the whales that we documented between June 1 and August 31, including one mother/calf pair, were identified on just one day (14 in Glacier Bay and 33 in Icy Strait). Of the 28 “new” whales that we documented between June 1 and August 31, 19 (68%) were identified on just one day (6 in Glacier Bay and 13 in Icy Strait). This suggests that the majority of the “new” whales in 2013 were transients in the GB-IS study area. Twenty-six (79%) of the 33 whales that we documented on one day only in Icy Strait were observed between July 1-25 in western Icy Strait (from Point Carolus to Idaho Inlet). This indicates that a pulse of transient whales may have passed through western Icy Strait in July; otherwise the sightings occurred over a broad range of dates and locations. The proportion of whales sighted on one day between June 1 and August 31 varies widely each year, with a range of 17%-42% since 1985.

Of the 47 whales that we documented on one day only between June 1 and August 31, we identified five of them again outside of the June 1 - August 31 monitoring period. At the same time, we documented seven additional whales on just one day outside of the June 1 - August 31 monitoring period. Therefore, the grand total of whales identified on one day only in 2013 was 49 individuals.

Reproduction and Juvenile Survival

We documented 10 mother/calf pairs in 2013 (Table 2) with the second lowest crude birth rate (4.2%) recorded since 1984, although this is a highly variable parameter (3.3%-18.5%; Table 3). On July 25 we documented a very small whale in a group of five whales that we initially identified as a calf based on its size and overall appearance; however, there was no apparent mother nearby. We had no further sightings of this small whale and we did not count it as a calf.

Table 2. Mother-calf pairs documented in 2013.

Mother ID#	Calf ID#	Documented in:
155	2549	GB & IS
193	2550	GB & IS
219	2551	IS
232	2552	GB & IS
941	2553	IS
1046	2554	GB & IS
1057	1057_calf_2013	GB & IS
1273	1273_calf_2013	IS
1302	2555	GB & IS
1486	2556	GB & IS

GB = Glacier Bay; IS = Icy Strait

Table 3. Reproduction and known age whales in Glacier Bay and Icy Strait, 1982-2013.

Year:	# Calves	# Calves Photo ID'd	% Calves Photo ID'd	Crude Birth Rate (%)	# Known Age Whales	Total # Whales
1982	6	3	50	-	-	-
1983	0	0	0	-	-	-
1984	7	5	71	17.9	-	39
1985	2	1	50	4.9	3	41
1986	8	5	63	16.3	2	49
1987	4	3	75	6.7	5	60
1988	8	5	63	14.8	4	54
1989	5	3	60	12.2	5	41
1990	6	6	100	12.2	7	49
1991	4	4	100	7.7	8	52
1992	12	10	83	18.5	7	65
1993	3	3	100	6.0	12	50
1994	9	5	56	15.0	10	60
1995	3	2	67	5.3	9	57
1996	6	3	50	7.8	18	77
1997	9	7	78	11.0	17	82
1998	8	7	88	8.7	18	92
1999	9	5	56	8.7	25	104
2000	3	2	67	3.3	23	90
2001	12	9	75	12.1	26	99
2002	11	6	55	12.9	23	85
2003	7	5	71	6.0	27	116
2004	16	12	75	11.5	36	139
2005	10	5	50	6.8	35	146
2006	13	8	62	8.7	41	149
2007	17	12	71	10.6	39	161
2008	15	12	80	9.4	52	160
2009	12	10	83	6.7	56	180
2010	21	15	71	10.9	55	193
2011	11	8	73	5.0	65	219
2012	16	14	88	7.7	60	209
2013	10	9	90	4.2	77	237
1982-2012 average:	8.8	6.3	68.6	9.8	26.4	100.6

Only includes whales documented during the June 1 - August 31 study period. Number of calves photo ID'd is the number of calves with fluke photos (vs. dorsal fin only photos). Crude Birth Rate (CBR) is a percentage computed by # calves / total whale count. CBRs for 1982 & 1983 could not be calculated because total whale counts for these years are not available. Number of known age whales does not include calves of the year. These data are not available for 1982-1984.

We identified three mother/calf pairs exclusively in Icy Strait, seven pairs in both Glacier Bay and Icy Strait, and no pairs exclusively in Glacier Bay. This was the first year since 1995 that no mother/calf pairs were sighted exclusively in Glacier Bay (NPS unpublished data). The seven pairs that used both Glacier Bay and Icy Strait reinforce the concept that the entire study area, not just Park waters, is important whale habitat. All of the mothers documented in 2013 were already known to be female based on sightings as mothers in previous years. As previously mentioned, one of the mother/calf pairs was identified on just one day (#1273 + calf on July 23).

We identified seven whales (five yearlings, one two-year-old and one four-year-old) that had not been documented in SEAK since they were calves in the study area. The number of yearlings was unusually high compared to recent years, when 1 - 2 yearlings have been typical; except for 2008 when we also documented a record-high of five yearlings (NPS unpublished data, Neilson and Gabriele 2008). In May (outside of the regular monitoring period), we identified another known-aged whale (six-year-old whale #2173) that had not been sighted since it was a calf near Juneau (NOAA unpublished data).

One of the yearlings that we identified in 2013 was whale #2483, the deformed calf of #944. In Neilson *et al.* (2013), we described the unusual appearance of this calf and speculated that multiple factors may have contributed to the animal's condition. For example, the calf may have been diseased, entangled, struck by a vessel and/or had congenital defects. Based on the calf's poor appearance and deformed flukes in 2012, we were surprised to document its survival in 2013. During two encounters in August and September, the animal behaved normally although it did not raise its flukes when diving. We identified it as whale #2483 based on the shape of the dorsal fin and the unique gray patches and dents on its body, which appeared similar to how they looked in 2012. Incidentally, 2013 was the first year that we did not observe adult male #1809 (age unknown, sex known from genetics) since we first documented this whale in the study area in 2003. For ten years, whale #1809 consistently appeared to be thin and unhealthy with wheezy respirations, a leaning dorsal fin, visible rib cage and unusually high concentration of cyamids (Doherty and Gabriele 2004).

The value of the longevity of this study is highlighted by the fact that 32% ($n = 77$) of the whales that we identified in 2013 ($n = 237$) were of known age, primarily from previous sightings in the study area. Overall, there has been an increasing annual trend in the proportion of known age whales as we accumulate long-term sighting histories of the whales in the study area. This means that our dataset is increasingly useful for estimating life history parameters such as age at first reproduction in females.

Genetics

In 2013 we collected a record-high number of sloughed skin samples ($n = 29$), including three samples from individually identified calves. It is rare for us to find sloughed skin with cyamids attached, but in 2013 three samples from adult whales each had a single cyamid attached (Fig. 4). Since 1996, we have collected 282 sloughed skin samples in the study area. Genetic analysis of these samples allows sex determination, definition of mitochondrial DNA haplotype and nuclear DNA genotyping. The only other practical ways we determine a whale's sex are if the whale returns to the study area with a calf (in which case we know that the mother is female) or in the infrequent event that we obtain photographs of the whale's urogenital area.



Figure 4. Cyamid attached to an unusually large sloughed skin sample from adult male #118. Photo courtesy of Sophie Pierszalowski.

Feeding Behavior and Prey Identification

For most of the summer, whales were notably scarce around Point Adolphus in Icy Strait. While low numbers of whales were present there, Point Adolphus never developed into the consistent hot spot of whale activity that has been typical of previous years. To our knowledge, it was the first summer since monitoring began in 1985 that the Point Adolphus “core group” apparently did not form, although we documented many of the whales commonly associated with the core group scattered around the study area.

In July, we documented unusually high numbers of whales feeding in western Icy Strait, primarily at the mouth of Idaho Inlet. We also received reports of dense concentrations of whales feeding in South Pass between Chichagof Island and the Inian Islands, just west of the study area.

Overall in 2013, capelin appeared to be unusually abundant in Icy Strait and lower to middle Glacier Bay compared to previous years. In early May, we positively identified juvenile capelin from a sample that we collected with a dip net near a whale that was feeding in Icy Strait. Between mid-July and mid-August, we positively identified adult capelin from five samples that we collected with a dip net near feeding whales in Icy Strait ($n = 4$) and Glacier Bay ($n = 1$) (Table 4) (Y. Arimitsu and C. Murdoch, pers. comm.). On six additional occasions between early June and late August we observed forage fish schooling in the water near feeding whales that we suspect were capelin based on their size, color and shape but we did not collect samples to confirm the species. On two of these occasions, we noted a distinctive cucumber smell in the air that likely indicated the presence of capelin. On four additional occasions between early June and late August we did not see any forage fish in the water but we noted a cucumber smell in the air near feeding whales that likely indicated the presence of capelin. In mid-July we observed and photographed a marbled murrelet (*Brachyramphus marmoratus*) eating a fish near a large group of feeding whales in lower Glacier Bay that we suspect was a capelin based on its size, color and shape. In early July, a charter fishing vessel captain reported that he had been seeing a lot of capelin around Point Carolus and in mid-July, we overheard a different charter vessel

Table 4. Humpback whale prey type determinations.

Method	Prey species (# of cases)			
	<i>capelin</i>	<i>capelin?</i>	<i>herring?</i>	<i>unknown species of forage fish</i>
<i>Collected specimen with dip net</i>	6			
<i>Nearby vessel jigged fish</i>	1			
<i>'Cucumber' smell in air</i>		4		
<i>'Cucumber' smell in air and fish observed near surface</i>		2		
<i>Fish observed near surface</i>		4	2	6
<i>Seabirds observed eating fish</i>		1		11

captain report over the radio that he was jigging capelin at the mouth of Idaho Inlet in Icy Strait. Several local trollers reported that the salmon they caught in Cross Sound had stomachs full of capelin.

While capelin dominated our 2013 whale prey observations, on two occasions we witnessed dense schools of fish boiling at the water's surface near Point Adolphus (July 24) and the middle of Icy Strait (August 9) that we suspect were herring based on their size, color and shape. In addition, sand lance were reported to be abundant near Lemesurier Island in June, with many whales feeding near shore (B. Christensen, pers. comm.). On 17 occasions we observed forage fish near feeding whales or we observed seabirds eating small fish near feeding whales but we were unable to identify the species. A local charter fishing vessel captain reported that herring, pollock and sand lance were unusually abundant and widely distributed in Icy Strait and Cross Sound.

Whale/Human Interactions

Whale waters

In 2013, a 13-knot vessel speed limit was implemented in lower Glacier Bay whale waters for 105 days. The duration of these speed restrictions has varied greatly from year to year depending on whale use in the lower bay, however, in recent years similarly long duration whale waters have become typical (2007-2012 range = 100 - 143 days). However, 2013 was unusual compared to recent years because whale activity in the lower bay fluctuated greatly within the season. In June, whale use of the lower bay decreased to the point that the vessel speed limit was temporarily raised from 13 knots to 20 knots for 11 days. However, by mid-July extremely high concentrations of whales were present in the lower bay (plus waters just north and south of the lower bay) and a special 10 knot speed limit for cruise ships was implemented for 14 days, while all other vessels were limited to 13 knots.

For the ninth year in a row, a large aggregation of whales centered around Point Carolus in Park waters in Icy Strait. This resulted in a prolonged 13-knot speed limit from May 8 - August 23 (108 days). In recent years we have become increasingly concerned about the frequent close proximity of humpback whales and charter fishing vessels around Point Carolus (Fig. 5). We are increasing our outreach efforts on whale-vessel collision avoidance to this user group.



Figure 5. Humpback whale breaching near a charter fishing vessel at Point Carolus.

In addition, a 13-knot speed limit was designated in temporary whale waters around the Marble Islands from June 7 - July 2 (26 days), in an area just north of lower bay whale waters from July 2 - August 2 (32 days), in Whidbey Passage from August 9 - September 26 (49 days) and in the middle of Glacier Bay northeast of Drake Island from September 17 - September 26 (10 days).

Vessel collisions

On June 13th, a 10-meter aluminum charter vessel was struck by a humpback whale near Point Adolphus in Icy Strait. The captain reported that the vessel was drifting in deep water with the engine and depth sounder turned off while his passengers watched about 15 humpback whales feeding nearby. Without warning, the vessel was suddenly struck very hard from below, lifting the vessel several feet into the air and tilting it abruptly sideways. Everyone fell to the deck, though no one was hurt. They did not see what struck the vessel, as the whale did not come up to breathe, but a short time later a large humpback whale surfaced a few hundred meters away and they presumed this was the individual that had struck them. Based on how hard they were hit, the captain believed that the whale was coming up fast when it struck the vessel, and speculated that the vessel may have been above a school of fish that the whale was targeting. The whale appeared to come towards the vessel two more times after the collision, even when the captain re-positioned the vessel to avoid it. The captain checked the vessel for damage and found a scuff mark on the paint where something had rubbed on it but no further damage. The fate and identity of this whale are unknown (NPS, unpublished notes).

On July 28th, a person paddling in a single kayak near Point Carolus at the mouth of Glacier Bay was capsized when a humpback whale surfaced underneath the boat. Many whales were feeding in the area. The kayaker was ejected, uninjured, into the water and the nearby motorboat from which the kayak had been launched assisted in retrieving her (NPS, unpublished notes).

A commercial fisherman in Cross Sound reported seeing a fast-traveling charter vessel strike a whale hard enough that the bow of the vessel was lifted up by the whale. The charter vessel operator resumed course and speed as if nothing had happened and did not mention the collision over the radio.

Elsewhere in Alaska in 2013, there were three other humpback whale-vessel collisions reported (two in SEAK and one near Kodiak - see Entanglement account below). In addition, the carcass of an unidentified baleen whale (possibly a sei or fin whale based on photos) was found pinned to the bow of a 260-meter container ship transiting from China to Panama. It is unknown when or where the strike occurred but the whale was discovered during routine maintenance when the vessel was approximately 900-1000 km south of the Aleutian Islands. When the ship slowed down and changed course, the carcass slipped off. The species was never confirmed and no further sightings were reported (NOAA Alaska Region unpublished data).

Dead whales

No dead humpback whales were found in the study area in 2013 but on May 11th, a pilot flying over the outer coast of GLBA reported seeing a large dead whale on the beach between La Perouse Glacier and Icy Point. He thought it was a gray whale (*Eschrichtius robustus*) based in its size and appearance. The carcass was moderately decomposed and had been scavenged by bears (C. Schroth, pers. comm.).

Elsewhere in Alaska, 15 dead humpback whales were reported in 2013 (five in SEAK, four near Kodiak, five in south central Alaska and one in western Alaska). However, three of the reports from SEAK may have referred to the same floating carcass (NOAA Alaska Region unpublished data).

On July 17th, a dead humpback whale was reported floating near Kake. The same carcass (confirmed with photos) was reported approximately 20 km to the west a week later by a passing cruise ship. On August 3rd a floating humpback whale carcass was reported off Coronation Island that may have been the same animal, but this could not be confirmed. On August 13th, a floating humpback whale carcass was reported west of Coronation Island that also may have been the same animal (NOAA Alaska Region unpublished data).

On August 29th a 10-meter male humpback whale in an advanced state of decomposition was found floating offshore of Cape Edgecumbe near Sitka. The carcass was examined at sea but the cause of death was not apparent. There were recent bite marks from predators inside the pectoral fins, on the trailing edge of the flukes, and on both sides of the mouth. Two days later the carcass was reported to have washed ashore on Kruzof Island. No necropsy was conducted (NOAA Alaska Region unpublished data).

On September 1st, another dead humpback whale was reported floating near Kake but this animal appeared fresh. A few days later, the 13.8-meter adult female washed ashore on a beach near Kake and a necropsy was conducted. There was extensive bruising and hemorrhaging along the right side of the body and pectoral fin which appeared to be the result of a ship strike (NOAA Alaska Region unpublished data).

Entangled whales

On June 25th, a charter fishing vessel captain reported that three humpback whales swam through and broke off a set of his salmon trolling gear in Beardslee Entrance in Glacier Bay. He reported that the braided nylon line suddenly “whizzed out” and snapped as the whales swam near his boat. He assumed that the line broke and slid off the whale(s), however he did not observe the whales closely to be able to confirm that none were entangled (J. Kearns, pers.

comm.). We were conducting a whale survey nearby and therefore suspect that the three whales were very likely adult females #235 and #535 and adult whale #465 (sex unknown). On subsequent surveys, we assessed these three individuals' flanks and caudal peduncles and did not see any entangling gear.

A similar incident occurred near Kodiak on June 19th when a humpback whale surfaced underneath an anchored 6.7 meter vessel while the occupants fished for halibut (also counted under "Vessel collisions" above). In this case, after the whale struck the vessel's hull and dove, the two people onboard found that their halibut fishing lines were paying out, at which time they cut the lines. The fate of this whale is unknown, but presumably the entanglement was not life-threatening (NOAA Alaska Region unpublished data).

Elsewhere in Alaska, four live humpback whales were reported entangled in fishing gear in SEAK and one humpback whale drowned in anchor cable near Kodiak (also counted under "Dead whales" above). One of the live entanglements involved an adult humpback that became entangled in a tended commercial gillnet near Petersburg on August 23rd. Multiple attempts were made to disentangle the animal, which was tracked with a satellite telemetry tag for 14 days as it traveled north from Petersburg up through Stephens Passage to the waters north of Juneau, then south down Lynn Canal and Chatham Strait, with its last sighting near Angoon. The animal, which was not individually identified, was partially disentangled and covered at least 805 km (435 nautical miles) before the effort was suspended and the tag was removed. No further sightings were reported and the fate of this whale is unknown (NOAA Alaska Region unpublished data).

In early July, we observed adult female #1907 with scars that appear to have been caused by an entanglement in line. There was a deep line wound on the left side of her head (Fig. 6) and a corresponding but much fainter line scar on the right side of her head, indicating that a line had wrapped around her head with asymmetric tension binding on her left side. We photographed #1907's caudal peduncle and flukes and did not see any scars indicating that the entanglement had involved these parts of her body. We did not detect any gear remaining on this animal and we presume that #1907 is no longer entangled. We were unable to pinpoint the timing or geographic location of this entanglement because we lack historic photos of the left side of #1907's head for comparison but we presume that the event was relatively recent based on the appearance of the scars (pink/unhealed on the left side and faint/presumably quick to heal on the right side).

Notable Behavioral Observations

On July 25th, we observed a whale surface lunge feeding near Point Carolus and our photographs later revealed that this whale was missing a large section of baleen from the right side of its mouth (Fig. 7). Based on a dorsal fin identification photograph of adult female #1906 that we took 11 seconds after photographing the lunge feeding whale, we believe that the whale with the damaged baleen is whale #1906, however these observations were made in a shoal of 25 whales so we cannot be certain of the identity of the whale with the damaged baleen.



Figure 6. Adult female #1907 on July 12, 2013 with a scar presumed to have been caused by an entanglement in line.

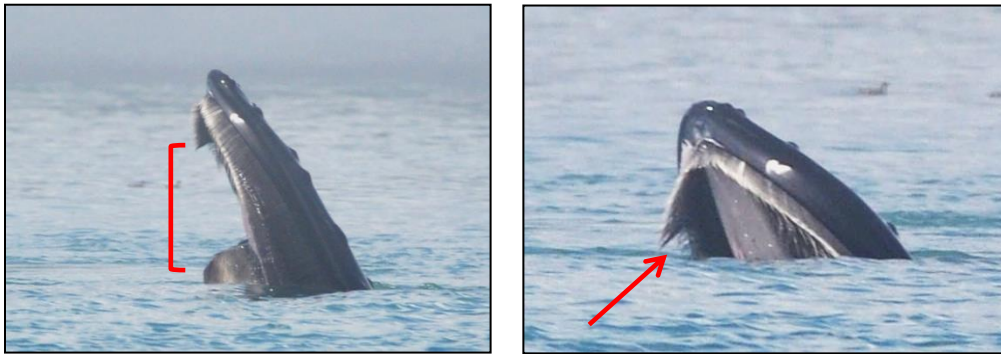


Figure 7. Humpback whale with damaged baleen lunge feeding off Point Carolus on July 25, 2013.

On July 26th, a humpback whale calf with skin that appeared to be whitish-yellow in color (Fig. 8) was reported off the south end of Yakobi Island (approximately 50 km SW of the study area) (Wayne Carnes, Merry Ellefson, Arne Ellefson-Carnes, pers. comm.). The cause of this calf's unusual appearance is unknown but we speculate that the calf may have had a skin disease and/or an infestation of cyamids. The calf's mother appeared normal in photographs but we were unable to individually identify her based on the dorsal fin images that we received. In early August, an 'albino' humpback whale calf that was described as having a pink eye (presumably the same animal) was reported off western Chichagof Island and off western Kruzof Island (J. Straley, pers. comm.).

On two occasions in August, we found freshly dead gulls that we speculate were unintentionally killed by surface lunge feeding humpback whales. Our first observation occurred on August 9th when we found a freshly dead adult glaucous-winged gull (*Larus glaucescens*) floating in the middle of Icy Strait in the vicinity of several surface lunge feeding humpback whales. Our second observation occurred on August 27th near a single humpback whale that was lateral lunge

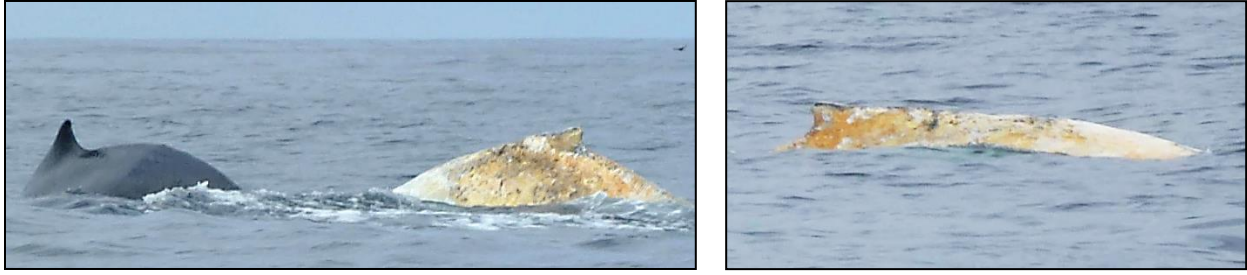


Figure 8. Humpback whale calf with unusual skin condition off Yakobi Island on July 26, 2013. Photos courtesy of Merry Ellefson.

feeding in Glacier Bay near the entrance to Berg Bay. We saw the whale lunge from a distance, and upon arriving at the approximate lunge site a few minutes later, we found a freshly dead black-legged kittiwake (*Rissa tridactyla*) floating in the water. The whale, #1894 (age 8, sex unknown), continued to surface lunge feed nearby under a large flock of gulls and murrelets. We cannot confirm that these individual gulls were killed by whales, but it is common for us to observe gulls and whales targeting the same prey (NPS unpublished data) and accidental engulfment and ingestion of seabirds by humpback whales have been documented previously in the study area (Neilson and Gabriele 2008, Haynes *et al.* 2013).

Between May 28th and August 29th, we found it notable that adult male #1489 (age unknown) and adult male #1065 (age 21) were associated with each other during 14 encounters. Group sizes during these encounters ranged from two to 15 whales. During this period, we had no encounters with #1489 without #1065 being present. We had two encounters with #1065 in July in which he was alone. In past years, we have observed #1489 and #1065 associating with each other, but not as regularly as in 2013. A few stable associations between males have been documented previously in the study area (Gabriele *et al.* 1995a) and long-term associations between mature humpback whale males and non-lactating females, and among non-lactating females, occur on the feeding grounds in the Gulf of St. Lawrence in Canada (Ramp *et al.* 2010).

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Appendix 1

Standardized (July 9 - August 16) and Total (June 1 - August 31) Humpback Whale Counts, 1985-2013

Year	GLACIER BAY		ICY STRAIT		GLACIER BAY & ICY STRAIT	
	standardized whale count	total whale count	standardized whale count	total whale count	standardized whale count	total whale count
1985	7	15	19	30	24	41
1986	26	32	22	32	39	49
1987	18	30	33	48	40	60
1988	19	41	29	36	40	54
1989	22	26	20	28	33	41
1990	16	25	24	33	36	49
1991	17	19	34	41	45	52
1992	27	34	34	50	49	65
1993	23	30	24	30	40	50
1994	17	29	29	42	44	60
1995	18	28	26	44	37	57
1996	37	44	43	59	64	77
1997	41	55	33	50	67	82
1998	46	63	27	50	68	92
1999	36	61	39	65	68	104
2000	44	59	26	58	62	90
2001	26	45	58	84	72	99
2002	28	44	34	61	56	85
2003	53	82	61	76	102	116
2004	85	112	38	64	110	139
2005	66	102	50	90	95	146
2006	66	82	98	121	130	149
2007	76	91	98	129	132	161
2008	56	86	98	139	126	160
2009	59	107	124	161	144	180
2010	78	131	97	145	141	193
2011	132	149	82	157	174	219
2012	87	125	144	177	176	209
2013	124	160	158	202	209	237
average:	46.55	65.76	55.24	79.38	83.55	107.45
stdev:	32.14	41.39	39.52	50.92	50.65	59.31

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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